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The
Supposed Inferiority of First
and Second Born Members
of Families
STATISTICAL FALLACIES

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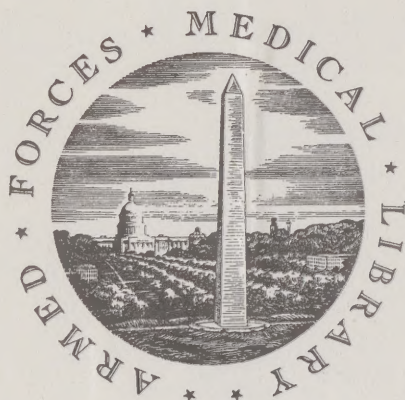
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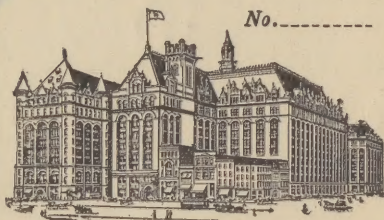
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T. L. MACALAY, M.A., F.R.S.
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The Supposed Inferiority of First and Second Born Members of Families

There is a general impression that while the study of eugenics may be interesting, it can be of but little practical value, owing to numerous and obvious difficulties in applying to the improvement of the human race the principles and methods which can be used in animal and plant breeding. Students of the science, while frankly recognizing this difficulty, have endeavored, nevertheless, to make their investigations as practical and helpful as possible. It has been thought by some that one foothold for practical work has been found in the supposed inferiority of the early born members of families which certain authorities claim to have discovered. If later born children are, on the average, superior to their elder brothers and sisters, then it is evident that the prevailing tendency towards small average families has a most serious significance apart altogether from its numerical effect upon the population, while all influences which tend to increase the size of families, tend also to prevent degeneration, and to improve the quality of the race. Several other important and discouraging assertions have also been made in this connection. It is, for example, claimed to be proved that the average families of the inferior classes of the community are even larger than those of the normal population.

Assuming the soundness of these theories, they have been used as texts for the criticisms of the child-labor regulations, and of other enactments designed to

improve the condition of the poor. These various assertions, therefore, deserve to be investigated most carefully, not merely for their own sake, but because of the far-reaching character of the theories of which they are the foundation.

I have before me Professor Karl Pearson's "First Study of the Statistics of Pulmonary Tuberculosis." If I venture to criticize this paper, I hope that my readers will clearly understand that I fully appreciate the great achievements of this eminent scientist, in a multitude of directions, which have made his name a household word amongst students of eugenics. Even giants, however, nap at times. Professor Pearson's paper, just mentioned, contains an analysis of the records of 381 families, with 2,164 members, each family having one member in the Crossley Sanatorium.

Tuberculous Families, number of each Class of Sibling

Sibling's order.....	1	2	3	4	5	6	7	8	9	10	11
Number of cases.....	381	366	332	289	247	185	126	86	57	35	21
Sibling's order.....	12	13	14	15	16	17	18	19	20	21	22
Number of cases.....	15	9	6	2	1	1	1	1	1	1	1

The tuberculosis patients from these families were distributed as follows :—

Tuberculous Patients

Sibling's order....	1	2	3	4	5	6	7	8
Number of cases observed.....	113	79	41	52	39	18	18	9
Number of cases calculated.....	67.1	64.4	58.5	50.9	43.5	32.6	22.2	15.1
% observed of cal- culated.....	168.4	122.6	70.0	102.1	89.6	55.2	81.1	59.6
Sibling's order....	9	10	11	12	13	14	Abv. 14	
Number of cases observed.....	3	3	3	1	1	1		0
Number of cases calculated.....	10	6.2	3.7	2.6	1.6	1.1		1.6
% observed of cal- culated.....	30	48.4	56.6					

Professor Pearson says:

"If we consider the community as a whole, it will
"be built up of families in all stages of development.
"There will be some in which both oldest and youngest
"siblings have passed through the tuberculous zone,
"some in which the eldest have and the youngest have
"not, and some in which the eldest are in it and the
"youngest have not reached it. Each one in his life-
"time passes through the danger zone, and we might
"expect, out of the totals that pass through, the same
"percentage would be attacked, whether they happen
"to be elder or younger siblings. In other words, if
"we take the Crossley Sanatorium population at a given
"date, we might expect that as far as position in family
"is concerned it would be drawn indifferently from all
"parts of the family."

The ratio of the 381 patients to the 2,164 members of the families to which they belonged is applied to the number of children of each order of birth, and the claim is then made that the resulting calculated numbers as given above are the numbers that should have been in the Sanatorium if the liability to tuberculosis were equally great in all members of each family, regardless of their order of birth. (See above table.) The actual numbers of inmates, it will be seen, are, among the early births, greatly in excess of the supposed normal numbers as calculated by Prof. Pearson, and are less than the numbers calculated for the later births.

Professor Pearson further presents a diagram which vividly illustrates the supposed greater liability to tuberculosis of the early born, and the supposed comparative immunity of the later born, and adds: "It will be obvious on mere inspection of this table, or of the accompanying graph, that the excess of elder born, and defect of younger born, is most marked."

The conclusion, as voiced by Professor Pearson, is: "In general, whether we deal with all tuberculous

"stocks, or only with those having no parental history, the elder offspring, especially the first and second, appear subject to tuberculosis at a very much higher rate than the younger members. If this special incidence on the earlier be found to be true for other forms of pathological heritage, we have a very serious factor of national deterioration introduced by the growing limitation of the family. It is further conceivable that any class which reproduces itself largely from the elder children, e.g., the peerage, as far as the father is concerned, would tend on the average to more rapidly degenerate. The substantiation in other cases of this pathological weighting of elder children, which appears true for the cases of tuberculosis and insanity, would be a eugenic fact of the greatest importance. The limitations of the family may not only be an evil, if it leads to a smaller relative output of the mentally and physically better stocks, but even in the case of feebler stock, it may lead to a relatively larger proportion of the more affected individuals being added to the community."

In his pamphlet on "The Problem of Practical Eugenics," the professor reproduces the diagram above mentioned, and adds other similar diagrams, showing the supposed greater liability to insanity, crime and albinism, among the earlier born. He adds:

"If our observations are correct, and I believe them to be so, then the mental and physical condition of the first and second born members of a family is differentiated from that of later members. They are of a more nervous, and less stable constitution. We find that the neurotic, the insane, the tuberculous, and the albinotic, are more frequent among the elder born. Dr. Goring's results from criminality show the same law. The diagrams I put before you bring this out; you see in the tuberculous, the insane and criminal stocks that the first few members are weighted. But the result of this law is remarkable. It means that if you reduce the size of the family, you will tend to decrease the relative proportion of the mentally and physically sound in the community. You will

“not upset this conclusion in the least, if, as I suspect, “the extraordinarily able man, the genius, is also “among the early born. For you will not lose him if “you have a larger family, although you will lose the “sounder members if you curtail it.”

From these supposed facts the professor draws some far-reaching conclusions, even claiming that they require a modification of the Mendelian theory. These arguments are certainly plausible, and the conclusions derived therefrom are most interesting. Before, however, we accept these conclusions, let us carefully consider the nature of the evidence on which they are based.

Let us consider first the statistics of tuberculosis. It is perfectly clear that the sanatorium contained larger proportionate numbers of early born patients than of later born of the 381 families. Does this, however, prove that early born children are more liable to the disease than later born of the same families? Not at all. Such a condition as that shown by these statistics was inevitable, and could have been foretold. Suppose, for instance, that of the 381 families included in the statistics, one consisted of fifteen children, the eldest twenty years of age, the youngest six months. If the eldest were the one who had developed tuberculosis, and entered the sanatorium, then all the fourteen younger brothers and sisters would be carefully tabulated and included in the numbers of tuberculosis stocks of the later born. Because fewer of such later born, and therefore young siblings, babies, perhaps, had become inmates of the sanatorium, we are asked to accept that fact as proof that later born children are superior to their elder brothers and sisters. It may be claimed that a family of fifteen is an extreme supposition, but the statistics before us include not only a family of fifteen children, but one of twenty-two. It is not won-

derful, however, that the statistics also show that at least the youngest eight of that family (all of the eight being probably young children, some of them possibly infants), were not inmates of the sanatorium, there being no inmates belonging to any group beyond the fourteenth born.

We are, however, told that "while a certain number "of families exist with young siblings in which the older "alone are likely to suffer, there are others in which "the older are dead, or past the danger zone, and in "which only the younger are likely to suffer," and he makes the assumption, therefore, that there will be enough older members of families whom he considers to be dead or past the supposed "danger zone," to offset the younger siblings. Unless this assumption be substantiated, that there is a special danger zone, and enough members of the families beyond it to affect the younger siblings, the foundation of the whole theory and of its developments is removed, and the entire structure collapses like a house of cards. When the vital importance of this assumption is thus realized, we would expect that some proof would have been produced in support of it, but the foundation is simply *assumed* to be there, and a great edifice is then endeavored to be built on it. To those who think the assumption is sound, we commend the following statistics from the report of the Registrar General of England and Wales, 1891-1900:

Annual Mortality from Phthisis per million living at various ages

Ages.....	0-4	5-9	10-14	15-19	20-24	25-34
	413	206	368	1144	1730	2135
Ages.....	35-44	45-54	55-64	65-74	75 and over	All Ages
	2592	2362	1881	1154	437	1391

In the face of such figures it is difficult to see how the claim can be supported that the older members are "past the danger zone," and therefore not likely to become inmates of a sanatorium. Not until age 75 does the death rate from phthisis descend to the neighborhood of what it is below age 15.

To sum up: In these tables the inclusion of children and babies who are not yet old enough to be exposed to the dangers in question, very clearly makes it inevitable that the groups of later born, to which these children belong, will show a more favorable percentage than the groups of early born, who are of necessity grown up. Professor Pearson, however, contends that there are as many people dead, or who have passed through the supposed danger zone, as there are children in the families not yet old enough to be exposed. This may be so, or may not be so. It is a tremendous assumption to make, and he does not produce proof in support of it.

The diagrams produced in regard to insanity and crime, are, as already mentioned, similar to that relating to tuberculosis. I have not before me the statistics upon which they are based, but there is little doubt that they have been prepared in the same manner. If so, the inclusion of young children among the later births renders these results also valueless. The later born groups, which include a considerable number of children, naturally have not developed as large a proportion of insane persons and criminals as the older adult members of their families. It cannot even be claimed that there is a danger zone in insanity and crime, such as was claimed for tuberculosis. The older siblings have in reality had just so much longer time to develop insanity or criminal propensities than the younger ones.

Let us consider, for example, the inmates of any penitentiary or asylum. Is it not certain that many of those inmates have brothers and sisters younger than themselves? Is it not equally certain that many of those younger siblings are so immature that, merely because of their youthfulness they have not yet committed any crime of sufficient importance to place them in the penitentiary? Some of them may be little more than babies—some of them actual babies. Can it reasonably be claimed that because these babies have not yet entered the penitentiary they are superior in moral quality to their elder brothers? Only the adult members of the families have had the opportunity to develop criminal propensities.

In regard to tuberculosis, the consideration of the question is complicated by the suggestion of a danger zone, and the claim that there may be sufficient persons past that zone to offset those who have not yet reached it. Even those who believe there is such a zone in the case of tuberculosis, will, however, hardly be likely to argue that if two criminals or insane persons be each aged twenty, and one of them has a brother fifteen years older (age thirty-five), while the other has a brother fifteen years younger (age five), then the elder brother may be considered to have passed the danger zone of crime or insanity, and to be no more likely to have developed criminality or insanity than the child of five, and that the man of thirty-five may be properly offset against the child of five.

Apart altogether, however, from the effect of including in the statistics the undeveloped members of the families, another consideration, not, however, probably productive of as marked an effect on the statistics, would lead us to expect that the early born groups would show higher percentages of individuals

lacking in robustness, or even given to crime. If one or other, or both parents die, for example, of consumption, at comparatively early ages, their average family will certainly be much smaller than in the case of couples neither of whom die prematurely. Parents of criminal, or semi-criminal tendencies, moreover, may not remain together sufficiently long in the marriage state to have large families, though on the other hand, some paupers and others may have families over the average. The children of these small tuberculous or criminal families would, of course, all fall into the earlier born groups, and as a result of heredity we would expect somewhat larger percentages of weak or criminal children in those groups. That, however, in no way indicates that early born children are inferior to later born of the same families.

Statistics which combine small and large families in one heterogeneous group are clearly valueless for our purpose. They may prove that tenth born children are superior to the average of *all* first or second born children, including those of families which contain but one or two members, an undue proportion of these latter being possibly from consumptive or criminal parents. But such statistics prove nothing as to the superiority of later born children over the elder born *of the same families*, and that is the point we are considering.

We now, however, come to another point which is claimed to have been made. It is stated that families containing tuberculous, insane or criminal members, are, on the average, larger than those of the total population. Is this contention well founded, or is it, too, a statistical fallacy?

I quote again from Professor Pearson's Study of the Statistics of Tuberculosis:

"The distribution of the 381 tuberculous families, "which may be practically considered as completed, "is as follows:

Size of Family.....	1	2	3	4	5	6	7	8
Number of Family.....	15	34	43	42	62	59	40	29
Size of Family.....	9	10	11	12	13	14	15	22
Number of Family.....	22	14	6	6	3	4	1	1
Total.....	381							

"Accordingly the mean family contains 5.68 offspring. "For the male pedigrees the mean size is 5.80, and for "the female pedigrees 5.59. Mr. Schuster finds the "mean size of families containing at least one deaf "mute to be from American statistics 6.08, and from "English statistics for probably completed families 6.19.

"It would thus appear that fewer offspring are not "born to stocks tainted with pulmonary tuberculosis.

"There is no reduced fertility in the case of tuber- "culosis; in fact their fertility is as great as that of any "other class in the community."

The professor compares the results obtained as above with the average size of families in the community as a whole, and claims that these statistics show that "the "families of the affected are larger, not smaller, than "those of normals."

Do these figures really prove that the tuberculous families of the community are on the average as large, or larger, than those of normal stocks? Most decidedly not. The mean family as given represents the mean for those particular 381 families, but it does not, and cannot, represent the average size of tuberculous families in the community as a whole. It is in fact impossible to ascertain the average size of a family in this manner. Statistics compiled in this way must always, and inevitably, overstate the average. These 381 families are treated as though they were indifferently chosen from the tuberculous families of the community, but this is not so. Such a selection is one of children, not

of marriages or of families, and the probability of any marriage being represented in the sanatorium is in direct proportion to the number of living children in the family. Marriages with a large number of children are very likely to be included. Marriages with but few children are correspondingly less likely; while childless marriages will not be represented at all. A marriage with ten children has ten times as great a chance of being included in the statistics as a marriage with but one child. A marriage with twenty-two children, like the one mentioned in the statistics, has twenty-two times the chance of being included that a marriage with but one child has, for there are twenty-two children who may develop tuberculosis as against one in the other case. The mean family derived from statistics so compiled clearly does not, and cannot, represent the average of the tuberculous families of the country, and to compare a result so found with the average size of a family in the community as a whole is to deceive ourselves.

Perhaps we will better appreciate the nature of these fallacies if we apply the same rules and reasoning by which they are produced, to a suppositious case. Let us imagine a community which contains 1,000 families of one child each, and 1,000 other families with ten children each. These 11,000 children in the 2,000 families give an average family, of course, of exactly 5.5. To simplify the problem, let us assume that the 10,000 children of the families of ten are so evenly distributed that there are precisely the same number of first born children living at every age, from twenty to forty-four inclusive, and that the ages of the children of the same families are precisely two years apart. This is a purely artificial grouping, but its very simplicity will help us to understand better the principles involved. It is of course quite proper for us to ignore families of which

no member has reached maturity, just as such families find but little place in the records of a sanatorium for Pulmonary Tuberculosis, or of an asylum or penitentiary. The 1,000 members of the families of one child are, we will say for convenience, divided evenly from ages twenty to forty-nine inclusive, there being forty living at each age.

When these materials are arranged according to order of birth, the following is the result:

Order of Siblings.....	1	2	3	4	5	
Age over 25.....	1520	680	600	520	440	
20—25.....	480	240	240	240	240	
11—19.....		80	160	240	320	
Total.....	2000	1000	1000	1000	1000	
Order of Siblings.....	6	7	8	9	10	Total
Age over 25.....	360	280	200	120	40	4760
20—25.....	240	240	240	240	240	2640
11—19.....	360	360	360	360	360	2600
2—10.....	40	120	200	280	360	1000
Total.....	1000	1000	1000	1000	1000	11000

We will now suppose that of the above group, 148, or exactly two per cent. of the total number of siblings beyond age 20, are college professors, the selection being made from each group in exact proportion to its members living at age 20 or over. I mean no disrespect to our professorial friends in naming this young age, choosing it merely in order to harmonize somewhat with the records of a sanatorium, asylum or penitentiary. Arranging these professors according to order of birth, and comparing them with the calculated number of cases which we should have if the professors were “drawn indifferent-ly from all parts of the family in proportion to the “total number of persons of each birth,” we get the following :

Statistics About Professors

Sibling's order.....	1	2	3	4	5
Number of Professors observed...	40	19	17	15	13
Number of Professors calculated..	26.9	13.5	13.5	13.5	13.5
Percentage of actual to expected cases.....	148	141	126	111	97
Sibling's order.....	6	7	8	9	10
Number of Professors observed..	12	11	9	7	5
Number of Professors calculated..	13.5	13.5	13.5	13.5	13.5
Percentage of actual to expected cases.....	89	82	67	52	37

May I take the liberty of applying in friendly banter the professor's words and arguments to the above suppositious case?

"It will be obvious on mere inspection of this table, "or of the accompanying graph, that the excess of elder "born, and defect of younger born, is most marked. "Testing by the usual process for goodness of fit we "conclude that the probability of such a distribution "of older and younger members of a family occurring "by random selection lies between one and two in the "ten millions trials."

We thus make what on its face would appear to be a very wonderful discovery. "It is very evident that "a much larger proportion of the older born members "of families become professors, and the first born are "evidently peculiarly subject to this dread complaint. "These statistics, when combined with the equally con- "vincing statistics in regard to tuberculosis, insanity, "crime and albinism, furnish conclusive evidence that "the older born, and particularly the first born, are on "the average inferior physically, mentally, and morally, "and that the later born are their decided superiors "in these respects."

A further and most interesting and important point is to be noted as to the fertility of professorial stocks. Grouping the professors in our statistics according to size of family, we find that twenty belonged to families

of one, and 128 belonged to families of ten. In the 148 families there were thus 1,300 children, the average size of the family being 8.8. This is a surprisingly high figure, and of course enormously greater than that of the general population. It furnishes convincing proof that "the families of the affected are larger, not smaller, than those of normals." The results are, in fact, so striking that we must really conclude that there is some connection between fertility and the tendency to professoritis. The exact nature of that connection, and which is cause and which is effect, we are not yet able to say, but the fact of a connection is obvious. It is not impossible that by increasing the number of professorships we may be able to bring into operation a force that may effectively combat the tendency towards degeneration in the community resulting from race suicide, for with their large average families, the numbers of later born, and therefore superior individuals, would be greatly increased. These statistics, moreover, confirm the necessity of modifying seriously our conceptions of the Mendelian theory, as already pointed out in connection with our study of tuberculosis.

My readers may smile at this; but this is precisely the reasoning which is used as proof of the theories in connection with eugenics, which we have been discussing.

In conclusion, it will be noted that I do not claim that elder born children may not possibly be inferior, on the average, to later born of the same families. What I do say is, that we should not be asked to accept this theory, and the far-reaching conclusions based on it, without positive and convincing proof.

The statistics, such as those given by Dr. Rivers and Prof. Pearson, in reality prove nothing.

If this theory be correct, it should be easy to establish that fact without relying on fallacies. Exclude from

the statistics all families with less than, say, five children; exclude, also, all children that are too young to have been fully exposed to the risk under consideration; compare the later born with the earlier born of their own families only; make allowance for the fact that in cases where the risk is continuous, or partly continuous, during adult life, a man in middle or old age has had a longer time to develop the trouble than one just reaching manhood; carefully exclude all other sources of error; then give us the results, and we will judge of the truth or otherwise of the theory. It is quite possible that the offspring of immature parents may be less robust than others; but the assertion that the first child born to a couple who marry at age thirty is more likely to be a degenerate one than the same child would have been had his parents married ten years earlier and had several children before him, will require a lot of proof.



The Supposed Inferiority of First and Second Born Children.

*Substance of Remarks by Mr. T. B. Macaulay
at Eugenics Congress, London,
July 26th, 1912.*

The claim has been frequently made, and strongly emphasised in both scientific and popular journals, that first and second born children of families are, on the average, inferior to their later born brothers and sisters physically, mentally and morally. If this claim were limited to cases where the parents of these early born children were immature, I would have nothing to say; but no such limit is imposed. The inferiority is said to hold quite regardless of the age of the parents.

This is a very important and very interesting question, and deserves careful investigation. I was led not long ago, purely from an actuarial interest, to examine the statistics on which the claim is based, and found, greatly to my surprise, that the statistics in question proved nothing of

the kind. A fallacy runs through almost all of them which utterly destroys their value. Possibly however the fact that I think this, will itself be considered by some as mere proof of my own degeneracy, for I myself am an eldest child !

How are these statistics prepared? The records of some institutions are taken on a basis, as for example, a sanatorium or penitentiary. The inmates are questioned as to the number of children in the families to which they belong, and their own order in their families. The number of inmates who are first born is then compared with the total number of first born children in the families; and so on with second, third and later born. The percentages thus found are higher in the case of early born inmates than of later born. That is certainly so, but what does it prove? Nothing! Absolutely nothing! Why? Because those later born members of the families are to a large extent children, perhaps even babies, and the percentages therefore must be higher for the older than for the younger. I said that these percentages prove nothing, but that is hardly correct. They do prove that children and babies are not as a rule old enough to develop consumption or be sentenced to penitentiaries—but that is all. Why, ladies and gentlemen, by statistics prepared in precisely that way I can prove almost anything. I can begin with this very audience now before me. It is certain that very many of you have younger brothers and sisters who are yet but boys and girls. The percentages of elder born among you will therefore certainly be decidedly in excess of those for the younger born. Would I be justified however in assuming from this that the composition of this audience

proves that first and second born children are mentally superior to their younger brothers and sisters? It would be very pleasant if I could pay you that flattering compliment, but truth compels me to say that all that such statistics would really prove would be that children and babies are too young to attend this congress.

Let us take another illustration. If we were to select a group of men weighing, say, not less than fourteen stone, the percentages of early born would certainly be greater than of later born. Would that however prove that first and second born children develop into larger, stronger men than the later born? Not at all! It would merely prove that boys and babies rarely weigh fourteen stone.

And so I might go on with other groups—doctors, clergymen, lawyers, married men, etc. From the very nature of the case, these higher percentages for elder born will be found to exist in almost all statistics based on groups selected because of some feature which develops only in adult life, or is chiefly associated with adult life, and in fact in almost all groups where the individuals are, for any reason whatever, chiefly or entirely adults. That these higher percentages should be found among inmates of sanatoria and penitentiaries was inevitable and could have being foretold, and their existence proves nothing whatever. Conclusions based on such a foundation are mere statistical fallacies.

But another claim has been made in this connection. The number of children in the families of the inmates of these institutions has been added up and the total thus found divided by the number of inmates. The average

thus produced has been shown to be larger than the average family in the total population. We have been told that this proves that the families of the afflicted are larger, not smaller, than those of the normal population. But do these figures prove that? Most certainly not! These institution figures are not based on marriages or families, but on children. A family of ten children has ten times as great a chance of producing a consumptive or criminal member as a family of one child only has. A family of twenty children has twenty times as great a chance, while a childless family would not be represented at all. To compare an average so found with the average size of family in the total population is to compare entirely different things and merely to deceive ourselves. This claim also therefore is found to be but another statistical fallacy.

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